THE STATISTIC ANALYSIS ON THE RETURNS OF THE BET, CAC 40 AND DOW JONES EURO STOXX 50 PORTFOLIOS

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Abstract: The BET, CAC 40 and Dow Jones EURO STOXX 50 portfolios present the overall trend of the financial markets in Bucharest, Paris and Euro zone. In this paper we analyzed the returns of these portfolios, which allow us to emphasize the characteristics of the returns that can be obtained on those three financial markets. The analysis was made by using descriptive methods, evaluating the autocorrelation and the dependence of the returns.

Key words: market indices, returns, autocorrelation, dependence

The BET, CAC 40 and Dow Jones Euro STOXX 50 market index Portfolios

On September 22nd, 2000, by the union of the stock markets of Amsterdam, Brussels and Paris, a unique market was born under the name of Euronext. Creating Euronext represented the first Pan-European Market for stocks and derived products. The three initial markets continued to run as branches necessary to register the stock quotes and set some regulations. The national indices of the three markets (AEX, BEL 20, CAC 40 etc.) were maintained. Besides, new indices of the unified market were calculated: EURONEXT 100, NEXT 150.

In order to characterize the European stock market we used the Dow Jones EURO STOXX 50 index, which is made up of the Euro zone stocks, instead of EURONEXT 100 index, because its portfolio contains only stocks from the financial markets of three European countries.

The BET Index Portfolio. The BET Index Portfolio is a 10-stock portfolio which lies at the foundation of BET index. The BET index was initiated at the Bucharest Stock Exchange on September 22nd, 1997. The main purpose of its creation is connected to reflecting the overall trend of the prices according to the 10 most liquid companies traded in the Bucharest Stock Exchange. Another goal of the BET index was to provide an adequate ground to transact derived tools on indices (options and futures contracts). BET is an index of Laspeyres type.

Stocks included in the BET portfolio have to meet the following requirements:
-to be quoted as of 1st Class at the Bucharest Stock Exchange;
-to have the highest financial capitalization;
-stocks to be chosen in such a way to assure the diversity of the index portfolio;
-stocks included in the index have to be the most liquid of the Bucharest Stock Exchange.

The CAC 40 Index Portfolio. As suggested by its name, the CAC 40 Index Portfolio is made up of the 40 most liquid stocks transacted at the Paris market. It was

created in June 1988 to represent the French financial market entirely and work as a support to the derived markets. Since it was founded, the CAC 40 index has been known as a reference point for the Paris market.

Its calculation method changed by the Decision of the Scientific Index Council on December 1st, 2003. The CAC 40 index is no longer weighted through the total financial capitalization of the sample stocks, but through floating capitalization. The floating market capitalization considers the stock financial capitalization by excluding the market capitalization of the following stocks:

-stocks owned by companies which issued them,

-stocks owned by persons who have power over the issuing company,

-stocks owned by the state,

-stocks linked through a contract signed between holders (contract according to the article 233/10 and 11 of the French Commerce Code).

This calculation method for the CAC 40 index ensured coherence between the quoted stocks and their reflection on the index.

The Dow Jones EURO STOXX 50 Index Portfolio. The Dow Jones Euro STOXX 50 Index Portfolio is made up of the most liquid stocks of the Euro zone (15) and the most important activity areas. 8 activity areas are specified, as follows: chemistry, raw materials, media, distribution, cars, cyclic goods, pharmacy, food industry, energy, banks, assurances, diversified financial services, conglomerates, constructions, equipment goods and professional services, technology, telecommunication, group services.

The Dow Jones EURO STOXX 50 Index is calculated, as the other indices, as a Laspeyres type index. Just like CAC 40, Dow Jones EURO STOXX 50 is calculated based on the floating financial capitalization of stocks.

Establishing the returns of the BET, CAC 40 and Dow Jones Euro STOXX 50 Index Portfolios

For an accessible interpretation, we will first determine the returns of the index portfolios through the rates of return. The BET, CAC 40 and Dow Jones EURO STOXX 50 rates of return are calculated on a monthly basis, between January 2000 - December 2004. The year 2000 was chosen as a debut for the analysis as, in Romania, it represents the beginning of the negotiations regarding the European economical integration.

In this study we analyzed the rates of return of the portfolios converted through logarithmization. If we record the rate of monthly return as LR (LRBET, LRCAC and LREUROX, respectively) and if P signifies the index value (PCAC and PEUROX, respectively) the calculation method is as follows:

$$LR_t = \left(LnP_t - LnP_{t-1}\right) * 100$$

The value of the BET portfolio is assessed in the national currency which is lei. In order to compare, we determined the BET portfolio returns according the index value in Euro:

$$LRBETL_t = \left(LnBETL_t - LnBETL_{t-1}\right) * 100$$

$$LRBETE_t = \left(LnBETE_t - LnBETE_{t-1}\right) * 100$$

where: - $LRBETL_t$ signifies the monthly returns converted through logarithmization expressed in Lei at time t;

- $LRBETE_t$ signifies the monthly returns converted through logarithmization expressed in Euro at time t;

In the following analysis, we refer to the monthly rate of return as the monthly rate of return converted through logarithmization expressed in percentages.

Before showing a descriptive analysis of the rates of return series for the chosen portfolios, we analyzed the evolution of their values.

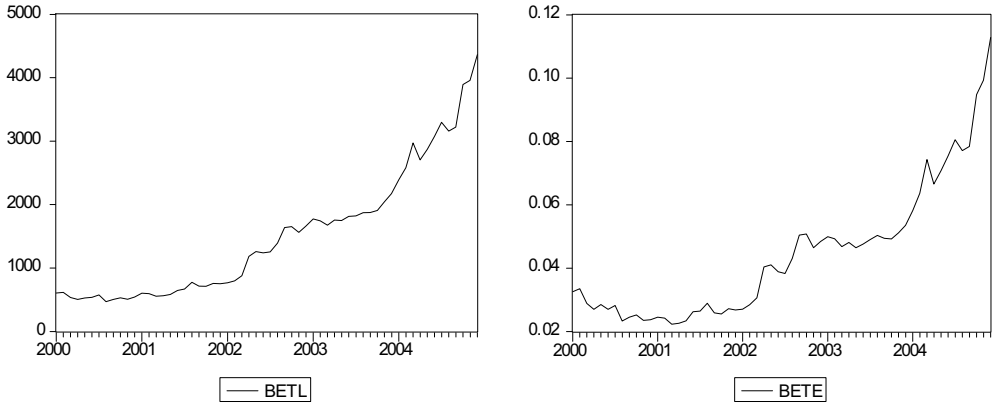

Figure no. 1 The evolution of the value of the BET portfolio expressed in Lei and Euro

During the entire period of analysis, the values of the BET portfolio expressed in Lei and Euro, respectively, show an ascending trend. The evolution of the Leu/Euro exchange rate indicates an ascending trend and represents the depreciation of the Leu during the entire period. The evolution of the BET portfolio value expressed in Euro also reflects the influence of the Leu-Euro exchange rate. This exchange rate follows a linear ascending evolution, between January 2000 - December 2004.

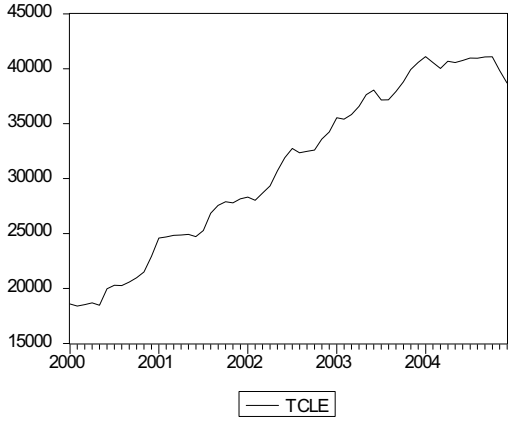

Figure no. 2 The evolution of the Leu-Euro exchange rate (1 Euro = TCLE Lei)

During the last months of 2004 we can notice a rise of the Leu (even if a slight one) which will influence the relative evolution of the BET value expressed in Euro and of the BET value expressed in Lei.

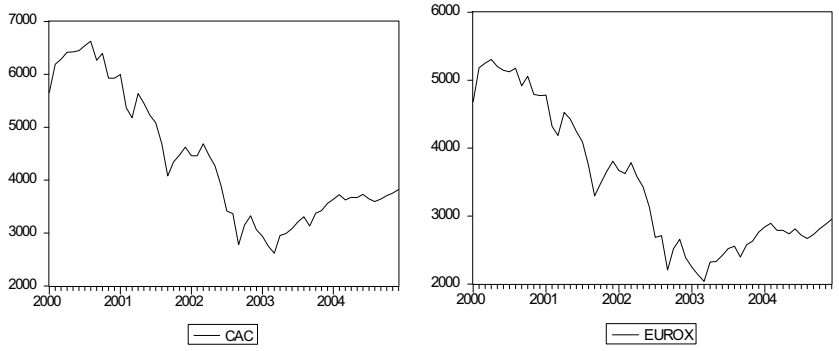

Figure no. 3 The evolution of the CAC 40 and Dow Jones EURO STOXX 50 portfolio values

The evolution of the CAC 40 and Dow Jones EURO STOXX 50 portfolio values are very close. Two periods may be identified in the evolution of these portfolios: a period of decrease until 2003 determined by the effect of a financial bubble and then a period of return. However, during the whole period, January 2000 - December 2004, the two portfolios describe a descending trend.

Descriptive analysis of the portfolio returns

A purpose of this study is to analyze the BET portfolio rate of return expressed in Lei but also in Euro because our analysis refers to two types of investors: the rate of return expressed in Lei is strategic for the Romanian investors who negotiate between the real assets and the Romanian financial assets, while the rate of return expressed in Euro is strategic for the international investors. The Romanian investors may be also interested by the rate of return expressed in Euro when having in mind the international diversification of their portfolios, protection against inflation in Romania and simultaneous depreciation of the Leu.

Table no. 1. Indicators of the central trend for the monthly rates of return of the BET, CAC 40 and Dow Jones EURO STOXX portfolios

Variable	Mean	Median	Test Value z	Likelihood associated to the test z	Number of observations
LRBETL	3,79221	3,58880	3.475958	0.0010	60
LRBETE	2,53512	2,65024	2.290568	0.0256	60
LRCAC	-0,74039	0,76191	-0.957181	0.3424	60
LREUROX	-0,84653	-0,18527	-0.941243	0.3504	60

N.B.: Results obtained with the support of EViews programme

The mean of the monthly rates of returns of the BET portfolio expressed in Euro is positive and high. It equals to 2,535% showing us that, on the average, in a month, an investor may get a return of 2,535%. The means of the rates of return of the CAC 40 and Dow Jones EURO STOXX 50 portfolios are negative and very close to zero. The CAC 40 and Dow Jones EURO STOXX 50 portfolios hardly register loss on the average, in a month; however, if we determine the losses on a whole year they turn out to be important.

The mean of the monthly rates of returns of the BET portfolio expressed in Euro is lower than the mean of the monthly rates of returns expressed in Lei because of the depreciation of the Leu against the Euro during the analyzed period.

To check if the mean of the monthly rate of return is significant and different from zero, we used the test z. The probability associated to the test indicates the following:

-the means of the monthly rates of return of the BET portfolio expressed in Lei and Euro are significantly different from zero (and considerably positive);

-the mean of the monthly rates of return of the CAC 40 portfolio is not significantly different from zero;

-the mean of the monthly rates of return of the Dow Jones EURO STOXX 50 portfolio is not significantly different from zero.

Since the mean of the monthly rates of return of the BET portfolio is significantly different from zero, we can say that the investors of the BET portfolio may hope to get significant returns. However the investors of the CAC 40 and Dow Jones EURO STOXX 50 portfolios may not benefit of such hope.

Given only the average rate of returns, we say it is preferable for a risk neutral investor to invest on the Romanian market rather than on the French or European one.

The median lines of the monthly rates of return of the BET portfolio expressed in Lei and Euro have positive values, showing us that more than a half of the values of the BET portfolio rates of return are positive.

The median line of the monthly rates of return of the CAC 40 portfolio, during the period we had in view, is positive and very close to zero. We can say the values of the rates of returns are almost equally divided into positive and negative values.

The median line of the monthly rates of return of the Dow Jones EURO STOXX 50 portfolio, during the period we had in view, is negative and very close to zero, which shows that the monthly results of the investment in this portfolio are equally divided into returns and losses.

Table no. 2. The values of the asymmetry and smoothing ratios for the monthly rates of returns of the BET and CAC 40 portfolios

Variable	Asymmetry Ratio	Pearson Curve Ratio
LRBETL	0.485979	5.185887
LRBETE	0.464967	4.497785
LRCAC	-0.491157	3.828834
LREUROX	-0.450405	4.043383

N.B.: Results obtained with the support of EViews programme

The monthly rates of return of the BET portfolio expressed in lei and Euro, respectively, show an asymmetry to the right. The appearance frequencies of the rates of return of the BET portfolio are displayed to the right (to the positive values of the rate of return).

The monthly rates of return of the CAC 40 and Dow Jones EURO STOXX 50 portfolios respectively, show both an asymmetry to the left. The distributions of the rates of return of the CAC 40 and Dow Jones EURO STOXX 50 portfolios are displayed to the negative values of the distribution.

The distributions of the monthly rates of return of the BET portfolio (expressed in Lei and Euro respectively), of the CAC 40 and Dow Jones EURO STOXX 50

portfolios are leptokurtic and the extreme values have higher rate of recurrence than the normal ones, showing „fat tails" (in French "queues de distribution épaisses"). If the investors own the BET, CAC 40 and Dow Jones EURO STOXX 50 portfolios they can get either exaggerated returns or extreme losses of higher occurrence than the normal ones.

We use the Jarque-Bera test to check the normality of the monthly rates of return. The monthly rate of return of the BET portfolio, expressed in Lei and Euro, do not follow normal distributions (probabilities associated to the Jarque-Bera test are lower than the taken risk of 5%). The monthly rates of return of the CAC 40 and Dow Jones EURO STOXX 50 portfolios are subject to a normal distribution.

Table no. 3. Values of the Jarque-Bera test for the monthly rates of returns

Variable	Value of the Jarque-Bera test	Probability associated to the Jarque-Bera test
LRBETL	14.30701	0.000782
LRBETE	7.770340	0.020544
LRCAC	4.129763	0.126833
LREUROX	4.750264	0.093002

N.B.: Results obtained with the support of EViews programme

Since the monthly rates of returns of the CAC 40 and Dow Jones EURO STOXX 50 portfolios are subject to normal distributions, their mean and variance are enough to characterize these distributions.

The evaluation of the portfolio returns autocorrelation

The analysis of the autocorrelation of the rates of return through the functions of autocorrelation has two goals [Jean-Pierre Berdot, 2003, p. 20]:

- it facilitates the definition of the character of the return rates process (AR – autoregressive, MA – moving average or ARMA autoregressive and of moving average);
- it determines whether or not the returns rates are correlated, the former theory being frequent in the theoretical and empirical literature of the financial markets.

To identify the process followed by the return rates, we can use the autocorrelation functions. For a random variable Y we can define two autocorrelation functions: the total autocorrelation function and the partial autocorrelation function.

The total autocorrelation function, TACF, is defined by the autocorrelation coefficient at lag k: $\rho_k = \frac{Cov(Y_t, Y_{t-k})}{\sqrt{V(Y_t)V(Y_{t-k})}}$. For a stationary variable the autocorrelation coefficient at lag k gets: $\rho_k = \frac{Cov(Y_t, Y_{t-k})}{V(Y_t)}$. Its calculation is:

$$\hat{\rho}_k = \frac{\sum_{t=k+1}^{t=T} (Y_t - \overline{Y})(Y_{t-k} - \overline{Y})}{\sum_{t=1}^{t=T} (Y_t - \overline{Y})^2}.$$

To test the null hypothesis (which supposes the absence of autocorrelation up to lag k) we use Ljung-Box's Q statistics as follows: $Q_k = T(T+2)\sum_{i=1}^{k}\frac{\hat{\rho}_i^2}{T-i}$.

The tested hypotheses are:

H_0: $\rho_1 = \rho_2 = \ldots = \rho_k = 0$

H_1: $\rho_1 \neq \rho_2 \neq \ldots \neq \rho_k \neq 0$

The null hypothesis supposes the absence of autocorrelation up to lag k and the alternative hypothesis supposes the presence of autocorrelation. Supposing the real hypothesis is null, the Q variable follows a law χ_k^2 (with k degrees of freedom).

The partial autocorrelation function, PACF, is defined by the autocorrelation at lag k. The partial autocorrelation of lag k is calculated by b_{kk} of the equation:

$$Y_t = b_{k0} + b_{k1}Y_{t-1} + b_{k2}Y_{t-2} + \ldots + b_{kk}Y_{t-k} + \varepsilon_t$$

The calculation of the parameter b_{kk} is done with the support of the smallest squares method.

Recognizing the process pursued by a variable by means of the autocorrelation functions is done as follows:

- a process AR(p) has an infinite function TACF convergent to o (in case of stationarity) and a function PACF at lag p;
- a process MA(q) has an infinite function PACF convergent to o (in case of inversability) and a function TACF cut-off at lag q;
- a process ARMA(p, q) has the functions TACF and PACF infinite and convergent (in case of stationarity and inversability) the lags p and q being determined by trials.

Table no. 4. Values of the autocorrelation functions and of the Ljung-Box test for the monthly rates of return of the BET portfolio

LRBETL				LRBETE			
AC	**PAC**	**Q-Stat**	**Prob**	**AC**	**PAC**	**Q-Stat**	**Prob**
0.021	0.021	0.0266	0.871	0.043	0.043	0.1189	0.730
-0.231	-0.232	3.4609	0.177	-0.155	-0.157	1.6649	0.435
-0.089	-0.083	3.9799	0.264	-0.099	-0.086	2.2988	0.513
0.121	0.074	4.9456	0.293	0.162	0.151	4.0422	0.400
0.121	0.085	5.9353	0.313	0.159	0.124	5.7480	0.332
-0.068	-0.037	6.2529	0.395	-0.051	-0.029	5.9269	0.431
-0.138	-0.085	7.5965	0.370	-0.147	-0.086	7.4464	0.384
0.075	0.067	7.9948	0.434	0.065	0.070	7.7491	0.458
0.023	-0.052	8.0347	0.531	0.074	-0.005	8.1527	0.519
-0.075	-0.070	8.4555	0.584	-0.003	-0.019	8.1534	0.614
0.029	0.068	8.5173	0.666	0.015	0.083	8.1709	0.698
-0.104	-0.142	9.3574	0.672	-0.152	-0.155	9.9606	0.619

N.B.: Results obtained with the support of EViews programme

Since all the probabilities associated to the Ljung-Box test are higher than 0,05 we will keep in mind the hypothesis on the absence of the monthly return rates autocorrelations.

Table no. 5. Values of the autocorrelation functions and of the Ljung-Box test for the monthly rates of return of the CAC 40 and Dow Jones EURO STOXX 50 portfolios

LRCAC				LREUROX			
AC	PAC	Q-Stat	Prob	AC	PAC	Q-Stat	Prob
0.000	0.000	2.E-06	0.999	-0.016	-0.016	0.0160	0.899
0.013	0.013	0.0111	0.994	0.031	0.031	0.0781	0.962
0.094	0.094	0.5930	0.898	0.034	0.035	0.1517	0.985
-0.123	-0.124	1.5944	0.810	-0.156	-0.156	1.7611	0.780
0.001	-0.001	1.5944	0.902	0.028	0.022	1.8149	0.874
0.193	0.193	4.1713	0.654	0.202	0.218	4.6268	0.592
-0.048	-0.030	4.3311	0.741	-0.067	-0.059	4.9418	0.667
0.117	0.099	5.3108	0.724	0.167	0.129	6.9433	0.543
-0.118	-0.163	6.3258	0.707	-0.162	-0.174	8.8667	0.450
0.028	0.092	6.3841	0.782	-0.015	0.048	8.8843	0.543
-0.057	-0.094	6.6327	0.828	-0.031	-0.065	8.9556	0.626
0.148	0.189	8.3230	0.759	0.132	0.172	10.300	0.590

N.B.: Results obtained with the support of EViews programme

The lack of the return rates autocorrelation suggests that the monthly rates of return follow a process ARMA(0,0), totally at random such as: $LR_t = c + \varepsilon_t$.

The calculation of c is the empirical mean of the rates of return and after the test it is not much different from zero for LRCAC. The calculation results of the process $LR_t = c + aLR_{t-1} + \varepsilon_t$ are shown in Table 6.

For the returns LRBET, the constant c is significantly different from zero since the probability associated to the test t is lower than 5%.

Table no. 6. The calculation results of the process $LR_t = c + aLR_{t-1} + \varepsilon_t$ followed by the monthly rates of return of the BET and CAC 40 portfolios

	c	prob. assoc t test	a	prob. assoc t test	R^2
LRBET	2.9409	0.006	0.04228	0.763	0.00175
LRCAC	-0.946	0.268	0.03810	0.779	0.00152

N.B.: Results obtained with the support of EViews programme

The estimated parameter a is not considerably different from zero for none of the analyzed rates of returns. The determination ratio R2 which is not much different from zero confirms that the rates of returns cannot be explained according to their previous values.

The evaluation of the return dependence

From the previous analyses, we reached the conclusion that the monthly rates of return of the BET and CAC 40 portfolios are not autocorrelated. However they may be dependent. The dependence signifies the situation when the high rates of returns (positive or negative) are followed by other high rates of returns, whatever their sign [Jean-Pierre Berdot, 2003, p. 24]. The presence of the return rates dependence suggests

they can be modeled with the support of the autoregressive conditioned models ARCH (Auto Regressive Conditional Heteroscedasticity).

To check the dependence we will calculate the autocorrelation functions of the return rates squares.

Table no. 7. Values of the total and partial autocorrelation functions of the monthly rates of return of the BET portfolio (expressed in Lei and Euro)

LRBETL				LRBETE			
AC	PAC	Q-Stat	Prob	AC	PAC	Q-Stat	Prob
-0.044	-0.044	0.1228	0.726	-0.068	-0.068	0.2896	0.590
-0.004	-0.006	0.1238	0.940	0.059	0.055	0.5161	0.773
-0.092	-0.093	0.6771	0.879	-0.065	-0.058	0.7941	0.851
-0.044	-0.052	0.8032	0.938	-0.042	-0.053	0.9094	0.923
0.087	0.082	1.3108	0.934	0.091	0.094	1.4748	0.916
-0.098	-0.102	1.9761	0.922	-0.100	-0.090	2.1677	0.904
0.160	0.148	3.7733	0.805	0.232	0.211	5.9461	0.546
0.032	0.057	3.8462	0.871	-0.046	-0.007	6.0976	0.636
-0.061	-0.071	4.1207	0.903	-0.087	-0.125	6.6506	0.673
-0.025	-0.014	4.1684	0.939	0.011	0.024	6.6595	0.757
-0.078	-0.047	4.6352	0.948	-0.102	-0.070	7.4461	0.762
0.004	-0.048	4.6365	0.969	-0.064	-0.146	7.7673	0.803

N.B.: Results obtained with the support of EViews programme

The values of the probabilities associated to the Ljung-Box test, calculated for the monthly return rates squares of the BET (expressed in Lei and Euro), CAC 40 and Dow Jones EURO STOXX 50 portfolios, respectively, indicate the absence of the dependence. There is no effect of autoregressive Heteroscedasticity. This way, the rates of returns with high values (positive or negative are nor followed by other higher rates of returns.

Table no. 8. Values of the total and partial autocorrelation functions of the monthly rates of return of the CAC 40 and Dow Jones EURO STOXX 50 portfolios

LRCAC				LREUROX			
AC	PAC	Q-Stat	Prob	AC	PAC	Q-Stat	Prob
0.188	0.188	2.2276	0.136	0.172	0.172	1.8599	0.173
0.217	0.189	5.2615	0.072	0.282	0.260	6.9518	0.031
0.191	0.132	7.6487	0.054	0.268	0.207	11.640	0.009
-0.022	-0.118	7.6810	0.104	-0.006	-0.147	11.643	0.020
0.025	-0.019	7.7237	0.172	0.015	-0.110	11.657	0.040
0.042	0.047	7.8427	0.250	0.048	0.047	11.818	0.066
0.145	0.176	9.3208	0.230	0.122	0.214	12.864	0.076
-0.168	-0.263	11.339	0.183	-0.157	-0.231	14.621	0.067
0.007	-0.007	11.342	0.253	0.031	-0.066	14.691	0.100
0.028	0.084	11.401	0.327	0.008	0.067	14.696	0.144
-0.107	-0.022	12.273	0.343	-0.101	0.045	15.463	0.162
0.204	0.198	15.488	0.216	0.143	0.141	17.057	0.147

N.B.: Results obtained with the support of EViews programme

Conclusions

We analyzed the BET portfolio rate of return, expressed in Lei, but also in Euro, since we took into account two types of investors. Thus, the rate of return expressed in Lei is strategic for the Romanian investors who choose between the real assets and the Romanian financial assets, while the rate of return expressed in Euro is strategic for the international investors. The Romanian investors may also show their interest in the rate of return expressed in Euro for an international diversification of their portfolios, to protect themselves against the Romanian inflation and the simultaneous depreciation of the Leu.

On the overall period of analysis, the values of the BET portfolio expressed in Lei and in Euro, respectively, indicate an ascending trend. The evolution of the Leu-Euro exchange rate shows an ascending trend and reveals the depreciation of Leu on the whole period. The evolution of the value of the BET portfolio expressed in Euro is a sign of the influence of the exchange rate Leu-Euro.

The evolutions of the values of the CAC 40 and Dow Jones EURO STOXX 50 portfolios are very close. During the whole period, January 2000 - December 2004, the two portfolios have a descending trend.

The investors in the BET portfolio may hope to obtain significant returns. Since the return rates distribution of the BET portfolio is leptokurtic, the investors may obtain either exaggerated returns either extreme losses with higher rate of recurrence than the normal ones. The rates of return of the BET portfolio are neither correlated nor dependent. That is why the return rates of this portfolio may not be foreseen.

The investors in the CAC 40 and Dow Jones EURO STOXX 50 portfolios may not expect considerable returns. If the rates of return of the BET portfolio did not follow a normal distribution, the rates of return of the CAC 40 and Dow Jones EURO STOXX 50 portfolios pursue a normal distribution. At the same time, the returns of these portfolios may not be foreseen.

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